INCH-POUND

MIL-PRF-32007

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PERFORMANCE SPECIFICATION

OILY WASTEWATER SEPARATION SYSTEM, 6.7-GALLON PER MINUTE NAVY INTEGRATED MEMBRANE SYSTEM (NIMS)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a fully automated and self-contained Navy Integrated Membrane System (NIMS) capable of providing treatment of oily wastewater found onboard Naval vessels at a rate of 6.7 gallons per minute (gpm). The effluent of the NIMS will contain no more than 15 parts per million (ppm) oil.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirement documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-680 - Degreasing Solvent

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to commandstandards@navsea.navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

MIL-S-901	-	Shock Tests H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for
MIL-DTL-5624	-	Turbine Fuel, Aviation, Grades JP-4, JP-5, and JP-5/JP-8 ST
MIL-PRF-9000	-	Lubricating Oil, Shipboard Internal Combustion Engine, High Output Diesel
MIL-D-16791	-	Detergents, General Purpose (Liquid, Nonionic)
MIL-PRF-16884	-	Fuel, Navy Distillate
MIL-PRF-17331	-	Lubricating Oil, Steam Turbine and Gear, Moderate Service
MIL-F-24385	-	Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater
MIL-DTL-24643	-	Cables and Cords, Electric, Low Smoke, for Shipboard Use, General Specification for
MIL-PRF-32097	-	Filtration Module, Oily Waste Membrane Type

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-167/1	-	Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited)
MIL-STD-461	-	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-740/1	-	Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment
MIL-STD-740/2	-	Structureborne Vibratory Acceleration Measurements Acceptance Criteria of Shipboard Equipment
MIL-STD-777	-	Schedule of Piping, Fittings, Valves, and Associated Piping Components for Naval Surface Ships
MIL-STD-810	-	Environmental Engineering Considerations and Laboratory Tests
MIL-STD-1310	-	Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety
MIL-STD-1399, Section 300	-	Interface Standard for Shipboard Systems, Section 300, Electric Power, Alternating Current (Metric)

MIL-STD-1553 - Digital Time Division Command/Response Multiplex Date Bus

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4/D, Philadelphia, PA 19111-5094 or http://astimage.daps.dla.mil/quicksearch/ or www.dodssp.daps.mil.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 1664 - Guidelines Establishing Test Procedures for the Analysis of Oil and Grease and Non-Polar Material

(Applications for copies should be addressed to Environmental Protection Agency, National Technical Information Service 5285 Port Royal Road, Springfield, VA 22161 or www.epa.gov.

NAVSEA DWG 803-6983497 - Membrane Module, Detail

(Copies of this drawing are available from Commander, Naval Sea Systems Command, ATTN: SEA 05Q, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents that are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013 - Reduced Pressure Principle Backflow Preventers

(Application for copies should be addressed to American Society of Sanitary Engineering, 901 Canterbury Road, Suite A, Westlake, Ohio 44145 or www.asse.org.)

ASTM International

ASTM D1141 - Standard Practice for Substitute Ocean Water

ASTM F1155 - Standard Practice for Selection and Application of Piping System Materials

ASTM F1166 - Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities

(Application for copies should be addressed to ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 45 - IEEE Recommended Practice for Electric Installations on Shipboard

IEEE 1284	-	IEEE Standard Signaling Method for a Bidirectional Parallel Peripheral Interface for Personal Computers
IEEE 1451.2	-	A Smart Transducer Interface for Sensors and Actuators - Transducer to Microprocessor Communcation Protocols and Transducer Electronic Data Sheet (TEDS) Formats

(Application for copies should be addressed to Institute of Electrical and Electronics Engineers, IEEE Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331 or www.ieee.org.)

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 12103-1	-	Road Vehicles -- Test Dust for Filter Evaluation -- Part 1: Arizona Test Dust

(Copies can be obtained on the Internet at http://www.iso.ch/)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	-	Enclosures for Electrical Equipment (1000 Volts Maximum)

(Application for copies should be addressed to National Electrical Manufacturers Association, 1300 N. 17th Street, Suite 1847, Rosslyn, VA 22209 or www.nema.org.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.1.1.

3.2 Material. The contractor shall select the materials, but the materials selected shall be capable of meeting all of the requirements specified herein. All materials shall be commercially available and conform to applicable commercial marine standards and practices. No toxic chemicals or hazardous substances shall be used.

3.2.1 Wetted materials. All materials in contact with the oily wastewater and/or processed byproducts shall be compatible, with no evidence of deleterious effect, with the following: seawater; diesel fuel marine fuels specified in MIL-PRF-16884; turbine fuels specified in MIL-DTL-5624, 2190 TEP steam lube oil specified in MIL-PRF-17331, and 9250 diesel lube oil specified in MIL-PRF-9000; and contaminants such as bleach, acetone, paint thinner, degreasing solvent specified in MIL-PRF-680 (Type III), and aqueous film forming foam specified in MIL-F-24385. In addition, all materials in contact with the mixture recirculated through the membrane filtration modules shall be both erosion and corrosion resistant (e.g., glass reinforced plastic, titanium, etc.) and not degrade performance of the membranes.

3.2.2 Dissimilar metals. Dissimilar metals shall not be used in intimate contact with each other unless protected against galvanic corrosion. Sacrificial anodes are not permitted.

3.2.3 Material deterioration, prevention and control. The NIMS shall be fabricated from compatible materials, inherently resistant to or treated to provide protection against corrosion and microbial deterioration for the system's service life and in any shipboard and storage environment specified herein.

3.2.4 Identification of materials and finishes. The contractor shall identify the specific material, material finish or treatment for use with component and subcomponent.

3.2.5 Electrical cable materials. All electrical cable materials shall meet the low smoke requirements of MIL-DTL-24643.

3.3 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.4 Environmental considerations. The NIMS shall be capable of meeting the following environmental requirements and operational constraints:

3.4.1 Shock. The NIMS shall meet the requirements of Grade B, Class I, Type A shock in accordance with MIL-S-901.

3.4.2 Environmental vibration. The NIMS shall meet the Type I vibration requirements in MIL-STD-167/1.

3.4.3 Internally excited vibration. All NIMS's rotating machinery shall meet the Type II vibration requirements in MIL-STD-167/1.

3.4.4 Airborne noise. The NIMS shall meet the requirements of airborne noise in MIL-STD-740/1 for Grade E equipment.

3.4.5 Structureborne noise. The NIMS shall meet the requirements of generated structureborne noise in MIL-STD-740/2 for Type II equipment.

3.4.6 Electromagnetic compatibility. The NIMS shall meet with the electromagnetic emissions and susceptibility requirements in MIL-STD-461 for auxiliary equipment operating in a machinery space of the intended ship, or class of ship (see 6.2).

3.4.7 Operational temperatures. The NIMS shall meet specified performance requirements when operating in an ambient air temperature environment range of 50 ^{o}F to 122 ^{o}F.

3.4.8 Storage (non-operating) temperatures. When in a non-operating state, the NIMS shall not be damaged nor shall subsequent operational performance be degraded as a result of being subjected to ambient air temperatures ranging from –40 ^{o}F to 158 ^{o}F.

3.4.9 Humidity. The NIMS shall not be damaged nor shall subsequent operational performance be degraded when subjected to the combined temperature and relative humidity profiles in MIL-STD-810, Method 507.4.

3.4.10 Inclination. The NIMS shall operate as specified herein and prevent loss of fluid when inclined at the rate of 5 to 7 cycles per minute in one phase to angles of 15 degrees on both sides of the vertical for a period of not less than 30 minutes.

3.4.11 Salt fog. The NIMS shall remain fully operational during and after a 48-hour exposure to salt fog as specified in MIL-STD-810, method 509.

3.5 Design. The NIMS shall consist of a primary separation system, a secondary separation system using filtration modules with membranes, a waste oil concentrate discharge system (see 6.6.1), a potable water distribution system, and a control system including sensors. The NIMS shall be a fully automatic and package-type (skid-mounted) unit ready for operation (turn-key system) with the ship's architecture. A pneumatic distribution system shall be required if the contractor design utilizes externally provided compressed air. Guidance for the NIMS design is provided in 6.3.2.

3.5.1 Separation systems. The NIMS shall incorporate a two-stage separation process consisting of primary and secondary separation systems. The primary separation system shall consist of a feed (see 6.6.4) subsystem (see 6.6.11) and a primary separator. The secondary separation system shall consist of two membrane filtration modules conforming to MIL-PRF-32097 and the interface requirements of NAVSEA DWG 803-6983497, installed in a cross-flow recirculation subsystem, and connected to a permeate discharge subsystem. The secondary separation system, with the filtration modules installed, shall maintain a 100-to-1 volume reduction factor (see 6.6.13) of the primary separation effluent (see 6.6.3). The interface requirements between the primary and secondary separation systems shall be as specified in 3.7.1.1. The filtration module interfaces shall be as specified in 3.7.1.2.

3.5.2 System connections. The NIMS inlet and outlet ship interface connections shall consist of the following: oily wastewater feed (suction) inlet, permeate discharge, concentrate discharge, flushing water discharge, potable water inlet, and if necessary, a compressed air inlet. The NIMS shall be equipped with the necessary electrical connections to receive ship-supplied electrical power, transfer data signals, and receive electrical signals from the ship's oily waste holding tank (OWHT) (see 6.6.7) and waste oil tank (WOT) (see 6.6.14) tank level reading switches. The NIMS shall also be equipped with sampling ports to allow manual sampling of oily wastewater feed, primary separation effluent, permeate (see 6.6.9) produced from each individual membrane filter module, and concentrated oil.

3.5.3 Size and weight. The NIMS shall not exceed 79 inches high by 102 inches wide by 42 inches deep and a wet weight of 5000 pounds when fully assembled.

3.5.4 Power consumption. The NIMS power consumption shall not exceed 23 kilowatts (kW), with a current draw not to exceed 30 amps steady state.

3.5.5 Compressed air consumption. The NIMS compressed air consumption shall not exceed 20 standard cubic feet per minute (SCFM). The average air consumption shall not exceed 5 scfm.

3.5.6 Grounding and bonding. Grounding and bonding of the NIMS electrical enclosure, pumps, and system frame to the ship's substructure shall be provided for electrical safety connection and an effective low-impedance RF connection as per MIL-STD-1310.

3.5.7 Markings. The NIMS shall have permanently affixed and legible markings located on the front of the unit that identify the NIMS manufacturer's name, model and serial number, national stock number (NSN), if specified (see 6.2). Each electrical enclosure shall have permanently affixed markings that identify the manufacturer's name, model and serial number, voltage, frequency, and maximum horse power rating, and low noise, if applicable. All system piping shall be identified for its specific service (i.e., potable water, etc.), pressure and direction.

3.6 Performance characteristics. The NIMS shall be capable of processing 7,000 gallons per week of oily wastewater based on an operating profile of 18 hours per week. The NIMS shall produce permeate water and concentrated oil from oily wastewater. The NIMS shall draw oily wastewater through the feed (suction) intake interface connection, deliver permeate for overboard discharge through the permeate discharge interface connection, and deliver concentrate for discharge to the ship's waste oil tank (WOT) through the concentrate discharge interface connection. Operation and control of NIMS shall be as specified in 3.6.7. The NIMS performance shall be compatible with the shipboard functional interfaces provided in 3.7.2.1.

3.6.1 Suction lift. The NIMS shall be capable of producing a suction of 10 psi on the oily wastewater feed line when operating at rated flow and pressure.

3.6.2 Concentrate discharge requirements.

3.6.2.1 Concentrate discharge flow. The NIMS shall deliver concentrate through the concentrate discharge connection at positive flow against a hydraulic resistance range of -3 to 22 psi.

3.6.2.2 Particulate removal. The NIMS shall automatically remove particulates greater than 150 microns from the oily wastewater feed stream upstream of the filtration modules. Accumulated particles shall be automatically purged and discharged as specified in 3.6.2.1. This purge cycle shall be activated automatically upon system shutdown and/or when the solids retention capacity is reached. Discharges of solid waste shall contain less than 5 gallons of fluid per cycle.

3.6.2.3 Water content. When processing non-emulsion mixtures and operating at rated flow and pressure, the percent volume of system influent discharged as concentrated oil (y) shall not exceed, on average, the value calculated for the corresponding system influent oil content percentage (x) using the equation below.

$$y = -1.0912x^2 + 2.0692x + 0.022$$

3.6.2.4 Emulsion and bulk oil processing. The NIMS shall be capable of diverting bulk oil and emulsion feed mixtures through the concentrate discharge connection as specified in 3.6.2.1.

3.6.3 Permeate discharge requirements.

3.6.3.1 Permeate discharge flow. The NIMS shall deliver permeate through the permeate discharge interface connection at a design flow rate of 6.7 gpm against a hydraulic resistance of 15 psi.

3.6.3.2 Oil removal. When operating at rated flow and pressure, the NIMS shall deliver permeate water as specified in 3.6.3.1 containing no greater than 15-ppm free oil, as measured by EPA 1664, for 95% of the time from oily wastewater feed mixtures defined in Table I. The oil removal capacity of the primary separation system shall be as specified in 3.7.1.1.

TABLE I. Oily wastewater test mixtures.

Mixture	Name	Constituents
A	Standard Mixture	Potable water containing: 1000-ppm Navy Oil Mix #4(1) (20 microns), 100-ppm detergent mixture(2), and 50-ppm of ISO 12103-1 fine test dust.
B	Heavy Detergent	Potable water containing: 1000-ppm Navy Oil Mix #4(1) (20 microns), 500-ppm detergent mixture(2), and 50-ppm of ISO 12103-1 fine test dust.
C	Heavy Oil	Potable water containing: 10,000-ppm Navy Oil Mix #4(1) (TBD microns), 100-ppm detergent mixture(2), and 50-ppm of ISO 12103-1 fine test dust.
D	Fibers	Potable water containing: 1000-ppm Navy Oil Mix #4(1) (20 microns), 100-ppm detergent mixture(2), and 50-ppm of ISO 12103-1 fine test dust, 114.2 grams of 100% polyester fibers (negatively buoyant, 7 inches long, 0.007 inch diameter) per 2,010 gallons of Standard mix (A).
E	Bulk Oil	Navy Oil Mix #4(1).
F	Emulsion	By percent volume: 70% potable water, 24% of oil mixture(3), and 6% of commercial liquid detergent (i.e., liquid Tide™, etc.).
G	Combination (A, F, & E)	Three separate mixtures by percent volume of A, F, & E total volume: 78% Standard Mix (A), 11% Emulsion (F), and 11% Bulk Oil (E). Mixtures shall be introduced separately and sequentially during testing. The sequence shall be as follows: mixture A is first, mixture F is second, and mixture E is last.
H	Standard Mixture w/AFFF	Standard Mix (A) and 25 ppm of Type 6 Aqueous Film Forming Foam (AFFF) conforming to MIL-F-24385.
I	Standard Mixture w/Saltwater	Standard Mix (A) and 35,000 ppm synthetic seawater conforming to ASTM D1141.

Notes:

(1) Navy Oil Mix #4 consists by percent weight of 50% MIL-PRF-16884, 25% MIL-PRF-17331, and 25% MIL-PRF-9000.

(2) Detergent mixture consists by percent weight of 50% MIL-D-16791 (Type I), 25% commercial liquid detergent (i.e., liquid Tide™, etc.) and 25% MIL-PRF-680, Type III.

(3) Oil mixture consists by percent weight of 51.2% MIL-PRF-9000, 39.5% MIL-PRF-17331 and 9.3% MIL-PRF-16884.

3.6.4 Flushing water discharge requirements.

3.6.4.1 Flushing water discharge flow. The NIMS shall deliver flushing water with residue through the flushing water discharge interface connection at positive flow against a hydraulic resistance range of –3 to 22 psi.

3.6.4.2 Self-cleaning cycles.

3.6.4.2.1 Primary separator cleaning cycle. The NIMS shall conduct a cleaning cycle of the primary separator, using no more than 100 gallons of ship-supplied potable water, discharging the flushing water and residue as specified in 3.6.4.1. This cleaning cycle shall be activated automatically upon system shutdown and shall be capable of being manually activated. In addition, this cleaning cycle shall be accomplished without disassembly of the separator.

3.6.4.2.2 Membrane back flush cleaning cycle. The NIMS shall conduct a back flush cleaning cycle of the filtration membranes as specified in MIL-PRF-32097, using no more than 40 gallons of ship-supplied potable water, discharging the back flush water as specified in 3.6.4.1. This cleaning cycle shall be activated automatically upon system shutdown and shall be capable of being manually activated.

3.6.4.2.3 Membrane hot flush cleaning cycle. The NIMS shall be capable of conducting a 6-hour hot flush cleaning cycle of the filtration membranes, using no more than 400 gallons of ship-supplied potable water at a self-heated temperature between 120 ^{o}F and 150 ^{o}F (max) and within the thermal shock conditions defined in MIL-PRF-32097, discharging the back flush water as specified in 3.6.4.1. The NIMS shall not be damaged nor shall subsequent operational performance be degraded as a result of being subjected to this procedure.

3.6.4.3 System drain. All NIMS drains shall be capable of draining through the NIMS flushing water discharge interface connection as specified in 3.6.4.1. The time to drain secondary separation recirculation loop shall not exceed 30 minutes. Compressed air may be used to facilitate system dewatering, given appropriate safety precautions.

3.6.5 Back flow prevention. The NIMS shall prevent back flow of oily wastewater, potable water, and compressed air (if used) into their respective ship supply sources. The NIMS shall also prevent permeate, flushing water and concentrate from backing up into their respective NIMS discharge port. A reduced pressure principle sanitary back flow preventer conforming to ASSE 1013 shall be used to protect the ship’s potable water from cross-contamination.

3.6.6 Compressed air moisture removal. If the NIMS utilizes dry compressed air, it shall be capable of automatically removing moisture from the supply air and discharging it to a ship-supplied bilge funnel.

3.6.7 Operation and controls. The NIMS control system shall monitor and control operation, report status, activate warning indicators, and sound alarms for all NIMS subsystems (i.e., primary separation, secondary separation, pneumatic, potable water, etc.). All NIMS subsystems shall self-monitor their respective operating parameters (i.e., flow, pressure, oil content, etc.). The NIMS control system shall interface with the ship’s centralized control system (Integrated Condition Assessment System (ICAS)) to provide remote monitoring and condition assessment. The NIMS’s control system shall also interface with the ship’s OWHT high, mid, and low-level tank reading switches and the ship’s WOT high-level tank reading switch.

3.6.7.1 Normal operation. Once the system has been powered up and valve alignment has been completed, the NIMS shall operate automatically, starting up when a mid level signal is received from the ship's OWHT. The NIMS shall automatically shutdown when there is no flow of oily wastewater feed entering NIMS or when a high level signal is received from the ship's WOT. As part of shutdown, the system shall automatically conduct the primary separator and membrane back flush cleaning cycles specified herein. The NIMS shall be capable of a manual mode that overrides the ship's OWHT and WOT tank level automatic controls to allow manual startup and shutdown of the system.

3.6.7.2 Controller. The NIMS control system shall automatically adjust the appropriate subsystems to maintain system operation and performance as specified herein and prevent system damage. The controller shall incorporate a programmable logic controller (PLC). Each module shall have removable terminal strips to allow PLC component replacement without disconnecting wiring. The control system shall incorporate a system control switch (OFF, AUTO and CLEAN), main power disconnect switch, emergency stop, and elapsed time meter for system pumps. The controller shall incorporate a message display unit that provides visible display of system status and has keypad pushbuttons to allow operator access to modes and conditions. The controller shall have the following additional control modes and features accessed through the message display unit:

a. Calibration mode that allows the user to monitor all sensors sequentially while adjustments is made.

b. Operator checks mode providing means of jogging pumps and valves.

c. Lamp and alarm test.

d. Totalized values reset.

e. Membrane integrity test mode.

f. Manual password protected mode.

3.6.7.3 Warning indicators. A visual warning indicator shall be activated when the filtration module set is no longer capable of processing at least 5 gpm indicating the membrane modules will soon require cleaning or replacement.

3.6.7.4 Alarms. Audible and visual alarms shall automatically activate and shut down the system when a shutdown condition occurs. All alarms shall be of the latching variety with reset. A method to silence the alarms shall be installed. All alarms shall employ procedures to prevent inadvertent or nuisance alarms during transient operations (i.e., system start-up, shutdown, etc.) or from transient conditions (i.e., electrical spikes or pulses, electronic noise, sea conditions, etc.). The NIMS shall not be damaged nor shall subsequent operational performance be degraded as a result of any alarm condition. Any of the below alarm conditions shall shut down the system, sound an alarm, and activate a visual alarm indicator.

a. Either one of the following oil contamination conditions occur:

   (1) Permeate exceeds 15-ppm oil contamination, or

   (2) Breach of the concentrate/permeate seal.

b. Membrane influent pressure outside the the upper or lower design operating range as specified in MIL-PRF-32097.

c. Temperature of the fluid in the cross flow recirculation loop exceeds the membrane filtration system's maximum allowable temperature specified in MIL-PRF-32097.

d. Filtration module set is no longer capable of processing at least 2 gpm (membrane modules require cleaning or replacement).

e. The NIMS no longer maintaining a 100-to-1 volume reduction factor.

f. Any sensor is not ON or is inoperative.

g. An overload trip has been activated.

h. A high level signal received from the ship's WOT liquid level reading system.

i. Improper valve actuation or pump failure.

j. Membrane face plugging or a recirculation loop blockage (i.e., membrane hydraulic resistance range is outside the operational range specified in MIL-PRF-32097).

k. The boundary between the concentrate and permeate has been compromised.

l. Air pressure too low for proper operation (if ship provided compressed air is used).

m. Loss of AC power to system or DC power in control circuitry.

3.6.7.5 Indicator panel. The NIMS shall display current status of the system locally and remotely. Local display shall be via a message display unit installed on the NIMS unit and remote display shall be via the ship's ICAS. The message display indicators shall be in English standard units.

a. The following status conditions and operating parameters shall be displayed locally and remotely at all times:

(1) System status (on, off, standby, running, operational cleaning, hot cleaning, alarm and warning conditions).

(2) Flow rate of permeate delivered by NIMS.

b. The NIMS shall be capable of displaying the following status conditions and operating parameters locally:

(1) Date and time (year, month, day, hour, and minute).

(2) Pressure of the primary separator oily wastewaster feed.

(3) Pressure of the primary separator effluent delivered into the secondary separation system.

(4) Pressure of the fluid in the cross flow recirculation loop.

(5) Trans membrane pressure (see 6.6.12) across the filtration modules.

(6) Pressure of the permeate discharged by the membrane modules.

(7) Flow or no flow of oily wastewater entering the primary separator.

(8) Temperature of the fluid in the cross flow recirculationloop.

(9) Oil content level of permeate delivered by NIMS.

(10) Total gallons of permeate delivered by NIMS. Totalizers shall be capable of being reset upon membrane change-out.

(11) Total gallons of concentrate delivered by NIMS. Totalizers shall be capable of being reset upon membrane change-out.

(12) Number of purge cycles defined in 3.6.2.2.

(13) Operating hours of each system pump.

(14) Operating hours of the primary separator.

(15) A high or mid level signal received from the ship's OWHT liquid level reading system.

(16) A high level signal received from the ship's WOT liquid level reading system.

3.6.7.6 Data logging. The NIMS's control system shall monitor and save values of the status conditions and operating parameters defined below and allow retrieval of this information. The control system shall be capable of saving data sets at 1-hour intervals for a period of 200 hours of operation before data retrieval is required. Retrieval of this data shall be provided via cable from the control system PLC to an external personal computer (PC). Data shall be a format compatible with text file reduction software including Microsoft Excel. Data logging and retrieval shall be provided for the following conditions and parameters:

a. Date and time (year, month, day, hour, and minute).

b. System status (running, operational cleaning, hot cleaning, alarm and warning conditions).

c. Pressure of primary separator oily wastewater feed.

d. Pressure of primary separator effluent delivered into the secondary separation system.

e. Trans membrane pressure across the filtration modules.

f. Pressure of the fluid in the cross flow recirculation loop.

g. Pressure of permeate delivered by NIMS.

h. Temperature of the fluid in the cross flow recirculation loop.

i. Oil content level of permeate delivered by NIMS.

j. Total gallons of permeate delivered by NIMS. Totalizers shall be capable of being reset upon membrane change-out.

k. Total gallons of concentrate delivered by NIMS. Totalizers shall be capable of being reset upon membrane change-out.

l. Number of purge cycles defined in 3.6.2.2.

m. Operating hours of the primary separator.

n. Bypass operation hours.

o. Concentrate/permeate seal integrity at least 20-second intervals (continuous monitoring is acceptable).

3.6.7.7 Sensors and instruments. Sensors used in the NIMS shall have minimum +/-0.5% accuracy for the system's design operational range. Sensors shall be capable of calibration adjustments and allow replacement without unwiring. A method shall be provided to prevent connectors from being misconnected.

3.7 Interface requirements.

3.7.1 Internal interfaces.

3.7.1.1 Primary-to-secondary separation interface. The primary separation system shall deliver effluent water into the secondary separation system at the flow rates and pressures required to support the filtration module performance specified in MIL-PRF-32097. When operating at rated flow and pressure, the primary separation effluent shall contain no greater than 300 ppm oil contamination, as measured by EPA 1664, from oily wastewater feed mixtures defined in Table I.

3.7.1.2 Filtration module interfaces.

3.7.1.2.1 Functional interface. The secondary separation system’s recircualtion subsystem shall maintain a maximum pressure of 100 psi or less, a maximum recirculation flow rate of 425 gpm or less, and ensure each filtration module operates within the performance requirements specified in MIL-PRF-32097. Permeate flow from each filtration module shall be controlled by the permeate discharge subsystem and maintained in the range of 2.6 to 3.7 gpm. The NIMS shall support all filtration module requirements specified in MIL-PRF-32097.

3.7.1.2.2 Physical interface. The physical interface between the filtration module and the secondary separation system shall be as defined in NAVSEA DWG 803-6983497. In addition, the interface between the filtration module permeate discharge connection and the permeate discharge subsystem shall be a flexible connection. All flexible permeate connections for the individual filtration modules shall connect to a rigid manifold.

3.7.2 Shipboard interfaces.

3.7.2.1 Functional interface. The NIMS’s functional interfaces with ship systems shall be compatible with the shipboard electrical, data, hydraulic, and pneumatic functional interfaces defined in Table II. The NIMS shall be capable of reading closure inputs in order to determine OWHT and WOT levels. The NIMS and the tank level reading device in the tank shall be electrically isolated from each other.

3.7.2.2 Physical interface. The NIMS’s interfacing pipe connections shall be compatible with the mating shipboard interface connection defined in Table II. The NIMS shall be skid-mounted with interfacing structural mounts capable of attachment to a steel deck without deforming or damaging the ship’s deck. The NIMS shall also be capable of being disassembled into subassemblies or components that can pass through standard Navy doorways 26 inches wide by 66 inches high, reduced further by round corners on a 8-inch radius, and hatches 30 inches wide by 60 inches long, reduced further by round corners on a 7.5-inch radius, and then being reassembled into an operational system.

TABLE II. Shipboard interface requirements.

NIMS Interface	Ship Interface (ship side of the interface)
Oily Wastewater Feed (Suction)	System: Oily Waste System, including OWHT Connection: 1.5-inch Nominal Pipe Size (NPS) with flange connection in accordance with (IAW) ASTM F1155 or MIL-STD-777 (see 6.2).
Permeate Discharge	System: Overboard Discharge System Connection: 1.5-inch NPS with flange connection IAW ASTM F1155 or MIL-STD-777 (see 6.2).
Concentrate Discharge	System: Waste Oil System, including WOT Connection: 1.5-inch NPS with flange connection IAW ASTM F1155 or MIL-STD-777 (see 6.2).
Flushing Water Discharge	System: Oily Waste System, including OWHT Connection: 1.5-inch NPS with flange connection IAW ASTM F1155 or MIL-STD-777 (see 6.2).
Potable Water Supply	System: Potable Water System Connection: 0.5-inch NPS with flange connection IAW ASTM F1155 or MIL-STD-777 (see 6.2). Supply characteristics: Pressure: Max. 75 psig, Min. 50 psig Temperature: 35 ^{o}F to 90 ^{o}F Bromine or chlorine residual: 0.2 mg/L
Compressed Air Supply (optional)	System: Compressed Air Service System Connection: 0.5-inch NPS with flange connection IAW ASTM F1155 or MIL-STD-777 (see 6.2). Supply characteristics: Pressure: Max. 120 psig at 20 scfm Min. 100 psig at 5 scfm Temperature: Max. 55 ^{o}F Water Content: Max. 25% liquid water Hydrocarbon Contaminant: Max. 50 ppm by weight Particulate Contaminant: Max. 5 microns
Electrical Power Supply	System: Electrical Power Distribution System Connection: see 6.2. Supply characteristics: IAW MIL-STD-1399, Section 300, Type I Power (440/115 Vac, 60 Hz, 3 phase). Note: Shipboard electrical power as defined in MIL-STD-1399, Section 300, is significantly different from commercial standards. Some supply characteristics, such as fault currents, harmonic current limits, and voltage variations, are more severe than those seen in a commercial environment.

TABLE II. Shipboard interface requirements - continued.

NIMS Interface	Ship Interface (ship side of the interface)
Data Exchange (Remote Monitoring)	System: Integrated Condition Assessment System (ICAS) Connection: see 6.2. Functional: IAW IEEE 45, IEEE 1451.2, IEEE 1284, and MIL-STD-1553 (see 6.2).
OWHT High & Mid Level Switch Signals	System: OWHT Liquid Level Reading System Connection: see 6.2. Functional: closure input signals for high and mid tank levels.
WOT High Level Switch Signal	System: WOT Liquid Level Reading System Connection: see 6.2. Functional: closure input signal for high tank level.

3.8 Hydrostatic integrity. The primary separation, secondary separation and potable water systems shall withstand hydrostatic pressure of 150% of their maximum allowable working pressure for a period not less than 30 minutes. When pressure is applied and maintained for the specified period, the NIMS shall be no sign of leakage, material deformation or rupture, or other defects that harmfully affect the performance and serviceability of the NIMS.

3.9 Reliability and maintainability.

3.9.1 MTBCF. The Mean Time Between Critical Failure (MTBCF) (see 6.6.2 and 6.6.6) of the system shall be at least 400 hours when the system is operated at rated capacity.

3.9.2 Maintenance ratio. The NIMS shall have a maintainence ratio (see 6.6.5) of not greater than 0.03. The time required to perform any preventive maintenance (see 6.6.10) action should be not greater than two man-hours by an Engineman third class or Electrician's Mate third class with no formal equipment training.

3.9.3 Maintenance access. All major NIMS assemblies and installed attachments shall be accessible for maintenance, repair, and replacement without the removal of other major assemblies and installed attachments not normally installed. The components shall be arranged so all maintenance can be performed with access from only the front of the system and one adjacent side.

3.9.4 Maintenance clearance. The clearance required for equipment removal and maintenance shall extend no further than 24 inches in the horizontal plane away from the unit front and adjacent side designed for access, and shall not exceed 79 inches from the unit bottom in the upward vertical direction.

3.9.5 Filtration module maintenance. The NIMS shall support the filtration module with membrane maintenance specified in MIL-PRF-32097.

3.9.6 Primary separator maintenance. The primary separator shall require no manual cleaning.

3.10 Safety. The NIMS shall present no uncontrolled hazards to operating or maintenance personnel. All electrical enclosures shall be NEMA 250 or equivalent.

3.11 Human factors. All man-to-machine interfaces (i.e., controls, displays, alarms, etc.) shall be suitable for user personnel with applicable fifth through ninety-fifth body dimensions as defined in ASTM F1166.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection. (see 4.1.1)

b. Conformance inspection. (see 4.1.2)

4.1.1 First article inspection. The first article inspection shall be performed on a minimum of one complete NIMS assembly. This inspection shall consist of examination of 4.2 and the tests specified in Table III.

4.1.2 Conformance inspection. The conformance inspection shall be performed on all NIMS assemblies and shall consist of the examination of 4.2 and the tests specified in Table III.

4.2 Examination. Each NIMS shall be examined for compliance with the requirements of 3.5, 3.5.1 through 3.5.3, 3.5.6, 3.5.7, 3.6.5, 3.6.6, 3.7.1.2, 3.7.1.2.2, 3.7.2.2, 3.9.3, and 3.9.4. This element of inspection shall encompass all visual examinations including verification of physical interfaces, operational parameters and capabilities, system design compliance, and dimensional measurements. Noncompliance with any specified requirements or presence of one or more defects shall constitute cause for rejection.

4.3 Tests.

4.3.1 Material test. Conformance to 3.2 shall be determined by inspection of contractor records providing proof or certification that materials conform to requirements. Applicable records shall include drawings, specifications, design data, receiving inspection records, processing and quality control standards, vendor catalogs and certifications, industry standards, test reports, and rating data.

4.3.2 Environmental verification tests.

4.3.2.1 Shock test. The NIMS shall be shock tested as a complete assembly (including filtration modules, valves, strainers, tanks, pumps/motors, inter-connecting piping, etc.) in accordance with MIL-S-901 as specified in 3.4.1. Since this test is often destructive, use of a nonfunctional membrane/housing is allowable.

4.3.2.2 Environmental vibration. The NIMS shall be tested in accordance with MIL-STD-167/1 as specified in 3.4.2.

4.3.2.3 Internally excited vibration. The NIMS shall be tested in accordance with MIL-STD-167/1 as specified in 3.4.3.

4.3.2.4 Airborne noise. The NIMS shall be tested for airborne noise in accordance with MIL-STD-740/1 as specified in 3.4.4.

4.3.2.5 Structureborne noise. The NIMS shall be tested for structureborne noise tests in accordance with MIL-STD-740/2 as specified in 3.4.5.

4.3.2.6 Electromagnetic compatibility. The NIMS shall be tested to determine conformance with the applicable electromagnetic emissions and susceptibility requirements in MIL-STD-461 as specified in 3.4.6.

TABLE III. Requirements and verification methods.

Requirement Title	Requirement Para.	1st Article Test Method	Conformance Test Method
Material	3.2	4.3.1	N/A
Wetted materials	3.2.1	4.3.1	N/A
Dissimilar metals	3.2.2	4.3.1	N/A
Material deterioration, prevention and control.	3.2.3	4.3.1	N/A
Identification of materials and finishes	3.2.4	4.3.1	N/A
Electrical cable materials	3.3.6	4.3.1	N/A
Environmental considerations	3.4	4.3.2	N/A
Shock	3.4.1	4.3.2.1	N/A
Environmental vibration	3.4.2	4.3.2.2	N/A
Internally excited vibration	3.4.3	4.3.2.3	N/A
Airborne noise	3.4.4	4.3.2.4	N/A
Structureborne noise	3.4.5	4.3.2.5	N/A
Electromagnetic compatibility	3.4.6	4.3.2.6	N/A
Operational temperatures	3.4.7	4.3.2.7, 4.3.2.8	N/A
Storage (non-operating) temperatures	3.4.8	4.3.2.7, 4.3.2.8	N/A
Humidity	3.4.9	4.3.2.9	N/A
Inclination	3.4.10	4.3.2.10	N/A
Salt fog	3.4.11	4.3.2.11	N/A
Design	3.5	4.2	4.2
Separation systems	3.5.1	4.2	4.2
System connections	3.5.2	4.2	4.2
Size and weight	3.5.3	4.2, 4.3.1	4.2
Power consumption	3.5.4	4.3.4	N/A
Compressed air consumption	3.5.5	4.3.4	N/A
Grounding and bonding	3.5.6	4.2	4.2
Markings	3.5.7	4.2	4.2
Performance characteristics	3.6	4.3.4	4.3.5
Suction lift	3.6.1	4.3.6	4.3.5
Concentrate discharge requirements	3.6.2	N/A	N/A
Concentrate discharge flow	3.6.2.1	4.3.6	4.3.5
Particulate removal	3.6.2.2	4.3.4	N/A
Water content	3.6.2.3	4.3.4	N/A

TABLE III. Requirements and verification methods – continued.

Requirement Title	Requirement Para.	1st Article Test Method	Conformance Test Method
Emulsion and bulk oil treatment	3.6.2.4	4.3.4	4.3.5
Permeate discharge requirements	3.6.3	N/A	N/A
Permeate discharge flow	3.6.3.1	4.3.6	4.3.5
Oil removal	3.6.3.2	4.3.4	4.3.5
Flushing water discharge requirements	3.6.4	N/A	N/A
Flushing water discharge flow	3.6.4.1	4.3.6	4.3.5
Self-cleaning cycles	3.6.4.2	N/A	N/A
Primary separator cleaning cycle	3.6.4.2.1	4.3.4	4.3.5
Membrane back flush cleaning cycle	3.6.4.2.2	4.3.4	4.3.5
Membrane hot flush cleaning cycle	3.6.4.2.3	4.3.4	4.3.5
System drain	3.6.4.3	4.3.4	N/A
Back flow prevention	3.6.5	4.2	4.2
Compressed air water removal	3.6.6	4.2	4.2
Operation and controls	3.6.7	4.3.6	4.3.6
Normal operation	3.6.7.1	4.3.4, 4.3.6	4.3.6
Controlling	3.6.7.2	4.3.6	4.3.6
Warning indicators	3.6.7.3	4.3.6	4.3.6
Alarms	3.6.7.4	4.3.6	4.3.6
Indicator panel	3.6.7.5	4.3.6	4.3.6
Data logging	3.6.7.6	4.3.6	4.3.6
Sensors and instruments	3.6.7.7	4.3.6	4.3.6
Interface requirements	3.7	N/A	N/A
Internal interfaces	3.7.1	N/A	N/A
Primary-to-secondary separation interfaces	3.7.1.1	4.3.4	4.3.5
Filtration module interfaces	3.7.1.2	N/A	N/A
Functional interface	3.7.1.2.1	4.3.6	4.3.5, 4.3.6
Physical interface	3.7.1.2.2	4.2	4.2
Shipboard interfaces	3.7.2	N/A	N/A
Functional interface	3.7.2.1	4.3.6	4.3.5, 4.3.6
Physical interface	3.7.2.2	4.2	4.2
Hydrostatic integrity	3.8	4.3.3	4.3.3
Reliability and maintainability	3.9	N/A	N/A
MTBCF	3.9.1	4.3.7	N/A
Maintenance ratio	3.9.2	4.3.8	N/A

TABLE III. Requirements and verification methods – continued.

Requirement Title	Requirement Para.	1st Article Test Method	Conformance Test Method
Maintenance access	3.9.3	4.2	4.2
Maintenance clearance	3.9.4	4.2	4.2
Filtration module maintenance	3.9.5	4.3.4	4.3.5
Primary separator maintenance	3.9.6	4.3.4	4.3.5
Safety	3.10	4.3.9	4.3.9
Human factors	3.11	4.3.10	N/A

4.3.2.7 High temperature. The NIMS shall be tested for high temperature storage and operation in accordance with MIL-STD-810, method 501.4, procedures I and II. The maximum test temperature for operating shall be the upper limit specified in 3.4.7. The maximum test temperature for the storage temperature shall be the upper limit specified in 3.4.8. The operating period for each test shall be one hour at the constant maximum temperature.

4.3.2.8 Low temperature. The NIMS shall be tested for low temperature storage and operation in accordance with MIL-STD-810, method 502.4, procedure I and II. The lowest test temperature for operating shall be the lower limit specified in 3.4.7. The lowest test temperature for the storage temperature shall be lower limit specified in 3.4.8. The operating period for each test shall be one hour at the constant minimum temperature.

4.3.2.9 Humidity. The NIMS shall be tested for the effects of a warm humid environment in accordance with MIL-STD-810, method 507.4 as specified in 3.4.9.

4.3.2.10 Inclination. The NIMS shall be tested for the effects of inclination as specified in 3.4.10. This test shall be repeated with the NIMS rotated 90 degrees through the vertical to the plane in which it was originally tested.

4.3.2.11 Salt fog. The NIMS shall be tested for corrosion, electrical and physical effects of aqueous salt atmosphere accordance with MIL-STD-810, method 509.2 as specified in 3.4.11. Duration of test shall be 48 hours exposure followed by a 48-hour drying time.

4.3.3 Hydrostatic pressure test. All pressurized portions of the NIMS shall be tested for the hydrostatic pressure requirements as specified in 3.8 using potable water supplied at temperatures between 120 °F and 130 °F for first article, and between 65 °F and 75 °F for production units. The test shall be performed with the filtration modules installed and a connection made between the permeate connection for each filtration module and the recirculation loop to preclude the development of excessive and potentially damaging trans-membrane pressure. In addition, all remaining shipboard interfaces, air relief valves, and potable water supply valves shall be secured. After the test, the system shall be drained and allowed to air dry.

4.3.4 Operational test (first article). This test shall demonstrate that the first article NIMS, with the functioning filtration modules installed, meets the processing capabilities and operational modes specified herein:

a. The system shall be operated for 80 runs at 5 hours per run for a total of 400 hours of operation as shown in Table IV.

b. The system shall process 6.7 gpm of oily wastewater influent containing 2,010 gallons of each of the feed test mixtures defined in Table I, and in accordance with the sequence specified in Table IV. All test mixtures shall be fed into the system in a manner that ensures complete mixing is reached. Samples shall be collected and analyzed in accordance with Table IV and 4.3.4.1 to verify the oil removal capabilities in 3.6.3.2 and 3.7.1.1.

c. The water content requirement in 3.6.2.3 shall be met during normal processing using sampling and volumetric measurement. The concentrate sample shall be allowed to settle for a period of 24 hours prior to determining the water volume in the concentrate. The volume of water in the oily wastewater feed delivered into NIMS shall be measured using volumetric measurement in accordance with EPA Method 1664, or calculated to known input. The volume ratio of concentrate water to oily wastewater feed water shall be computed to verify the requirement in 3.6.2.3.

d. The system shall complete an automatic membrane back flushing cleaning mode as specified in 3.6.4.2.2 at the end of each run (as a result of a predetermined time set when feed inflow is zero) and after the system goes into shutdown mode. The test setup shall have a meter installed at the potable water supply connection to verify consumption of water does not exceed that specified in 3.6.4.2.2.

e. A 6-hour membrane hot flush cleaning shall be performed after completing test run numbers 20, 40, 60 and 80 to demonstrate the self-cleaning capabilities in 3.6.4.2.3. The test setup shall have a meter installed at the potable water supply connection to verify consumption of water does not exceed that specified in 3.6.4.2.3.

f. The primary separator shall perform an automatic cleaning mode as specified in 3.6.4.2.1 after every shutdown mode. The primary separator shall go into flush and drain mode once. Ensure that the flush and drain modes operate correctly. The test setup shall have a meter installed at the potable water supply connection to verify consumption of water does not exceed that specified in 3.6.4.2.1.

g. Particulates in the NIMS influent shall be removed and purged as specified in 3.6.2.2 after every shutdown mode and when the solids retention capacity is reached during test runs 21 through 24.

h. If the system uses externally provided compressed air, the test setup shall have a meter installed at the air supply connection to verify the amount of compressed air consumed by NIMS after twenty-four hours of operation does not exceed that specified in 3.5.5.

i. Power consumption shall be measured on a periodic basis during the testing to verify consumption rates do not exceed that specified in 3.5.4.

j. Upon completion of all runs shown in Table IV, the system shall be completely drained within the time constraints specified in 3.6.4.3. The filtration modules shall be removed and replaced.

4.3.4.1 Sampling. A minimum of 66 primary separator effluent samples, 66 permeate samples, 20 concentrate samples and 20 oily wastewater feed samples from the NIMS shall be collected accordance with EPA Method 1664 during the test at the intervals stated in Table IV. Ten spiked samples shall be analyzed for quality control purposes. The samples shall be taken by opening the sampling valves provided on the NIMS prototype during the operation. A minimum of three quality control (QC) standard samples containing 15-ppm Navy oil Mix # 4 and three standard samples containing 100 ppm Oil Mix # 4

(prepared by an independent laboratory) shall be inserted randomly into the analysis matrix to evaluate the analysis of laboratory's accuracy. The performance test shall be not be accepted if the feed samples contain, on average, less than 60 percent of the intended oil content. Oil samples shall be collected sequentially in the following order as follows:

a. First sample – oily wastewater feed

b. Second sample – primary separator's effluent

c. Third sample – membranes' permeate

d. Fourth sample – combined primary separator/membrane concentrate

Samples shall be taken based on the hydraulic residence time, starting with the first set of samples and then in sequential order as described in the above. Based on the hydraulic residence time of the primary separator and the membrane loop, the test fluid shall have enough time to replace the fluid from the previous condition.

TABLE IV. Test sequence.

Run Numbers (Total runs)	Feed Test Mixture (see Table I)	Duration Per Run	Primary Separator's Effluent (Sampling frequency)	Membrane's Permeate (Sampling frequency)	Feed and Concentrate Samples (Sampling frequency)
1-4 (4 runs)	A Standard Mixture	5 hours	4 (1 per run)	4 (1 per run)	1 (1 per 4 runs)
5-12 (8 runs)	B Heavy Detergent	5 hours	8 (1 per run)	8 (1 per run)	2 (1 per 4 runs)
13-20 (8 runs)	C Heavy Oil	5 hours	8 (1 per run)	8 (1 per run)	2 (1 per 4 runs)
21-24 (4 runs)	D Fibers	5 hours	4 (1 per run)	4 (1 per run)	1 (1 per 4 runs)
25-28 (4 runs)	E Bulk Oil	5 hours	4 (1 per run)	4 (1 per run)	1 (1 per 4 runs)
29-36 (8 runs)	F Emulsion	5 hours	8 (1 per run)	8 (1 per run)	2 (1 per 4 runs)
37-52 (16 runs)	G Combination (A, F, & E)[1]	5 hours	16 (1 per run)	16 (1 per run)	4 (1 per 4 runs)
53-56 (4 runs)	A Standard Mixture	5 hours	2 (1 per 2 runs)	2 (1 per 2 runs)	1 (1 per 4 runs)
57-64 (4 runs)	H AFFF	5 hours	4 (1 per run)	4 (1 per run)	2 (1 per 2 runs)
65-68 (8 runs)	A Standard Mixture	5 hours	2 (1 per 4 runs)	2 (1 per 4 runs)	1 (1 per 8 runs)

TABLE IV. Test sequence – continued.

Run Numbers (Total runs)	Feed Test Mixture (see Table I)	Duration Per Run	Primary Separator's Effluent (Sampling frequency)	Membrane's Permeate (Sampling frequency)	Feed and Concentrate Samples (Sampling frequency)
69-76 (4 runs)	I Saltwater	5 hours	4 (1 per run)	4 (1 per run)	2 (1 per 2 runs)
77-80 (8 runs)	A Standard Mixture	5 hours	2 (1 per 4 runs)	2 (1 per 4 runs)	1 (1 per 8 runs)

Notes:

(1) Mixtures shall be introduced separately and sequentially during testing. The sequence shall be as follows: mixture A is first, mixture F is second, and mixture E is last.

4.3.5 Operational test (production units). The NIMS shall be operated at rated flow and pressure for 2 hours to demonstrate system operates within operating parameters specified 3.6 and safety requirements in 3.10.

4.3.6 Functional test. The NIMS shall be operated under all interface conditions for a period of not less than 1 hour to verify the control system's functional operation as specified in 3.6.7 and all subparagraphs, suction lift capability in 3.6.1, concentrate discharge flow capability in 3.6.2.1, and permeate discharge flow capability in 3.6.3.1, flushing water discharge flow capability in 3.6.4.1, filtration module functional interface requirements in 3.7.1.2.1, and ship functional interface requirements in 3.7.2.1. All warning and alarm conditions described herein shall be simulated to verify all NIMS warning indicators and alarms function correctly. All sensors and instruments shall be supplied a source to verify sensor calibration and displayed value on the system's message display unit.

4.3.7 MTBCF. The operational test shall demonstrate the NIMS complies with the MTBCF requirement specified in 3.9.1.

4.3.8 Maintenance ratio. The scheduled and unscheduled maintenance shall be timed, accumulated and converted to a maintenance ratio during first article testing. Only scheduled maintenance in the manufacturers recommended maintenance schedule shall be permitted.

4.3.9 Safety. The NIMS shall be evaluated throughout testing for safety requirements in 3.10.

4.3.10 Human factors. The OWMS-50 shall be inspected and evaluated throughout testing for human factor requirements in 3.11.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature, which may be helpful, but is not mandatory.)

6.1 Intended use. The NIMS described in this specification is intended for use onboard Naval ships to process oily wastewater, to consistently produce an effluent containing no greater than 15-ppm oil content. The overall intended service life of the NIMS is 30 years minimum with an operating life expectancy of 20,000 hours minimum.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of the specification.

b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1)

c. Packaging requirements (see 5.1).

d. Ship or class of ship, or specific application for which the NIMS is intended, interface location specifications, interface connection specifications, electromagnetic emissions and susceptibility requirements, and ICAS interface specifications.

e. When first article is required (see 3.1).

f. Material certificates (see 4.3.1).

6.3 System requirements. Additional information regarding the Navy studies in the field of ultrafiltration may be found on the Internet. Website URLs will be provided by the procuring activity upon request. Developmental information originates from Naval Surface Warfare Center, Code 634, Bethesda, MD.

6.3.1 Recommended test material. Test conducted at Naval Surface Warfare Center used liquid Tide™ as the commercial laundry detergent.

6.3.2 Recommended filtration module configuration. The recommended configuration of the filtration modules within the NIMS is shown in Figure 1.

6.3.3 Recommended water heating method. Heating of the ship provided potable water during a membrane hot flush is recommended to be entirely by the action of the recirculation pump.

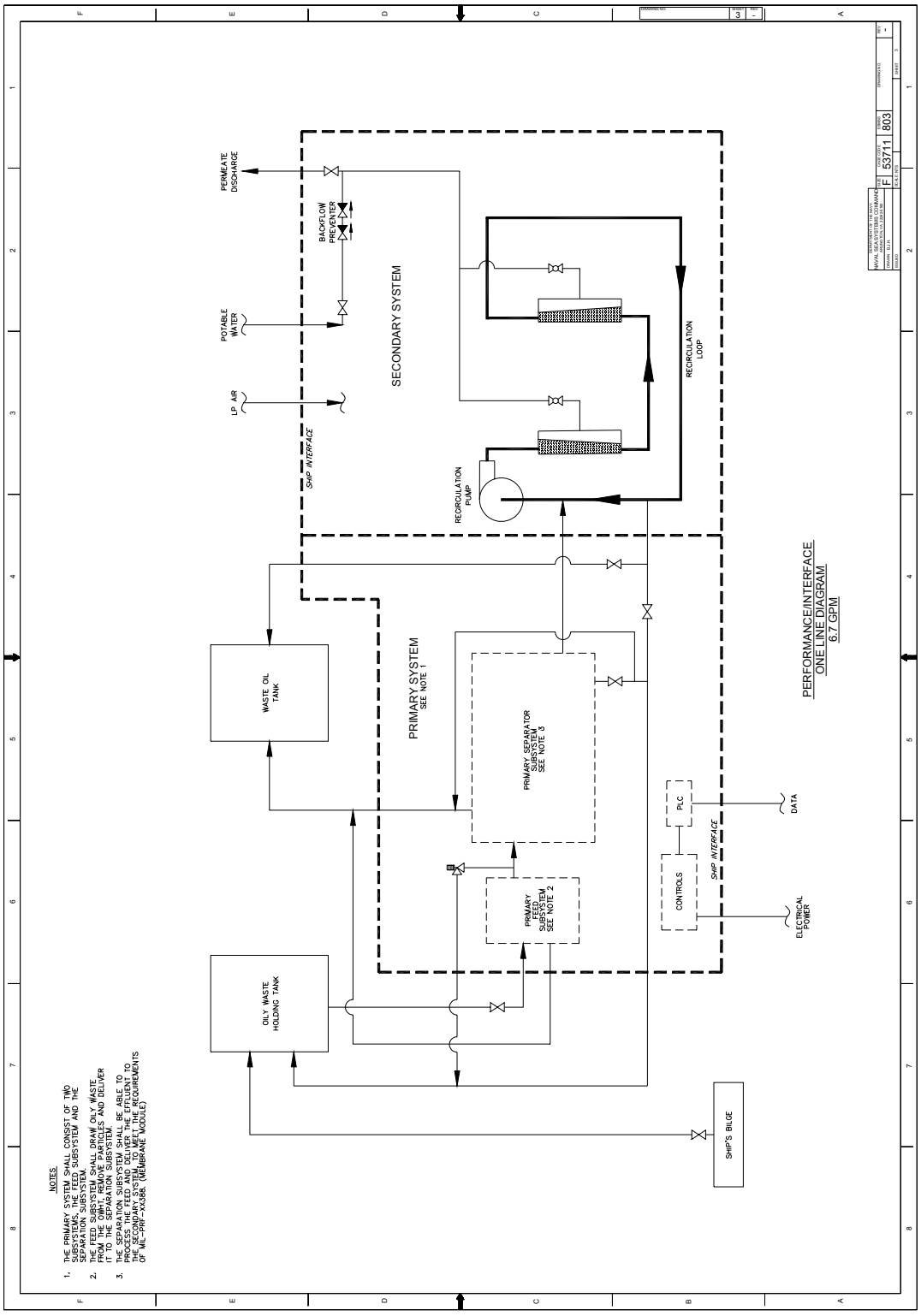

FIGURE 1. Recommended NIMS configuration.

6.3.4 Design assumptions. The OWHT and WOT size on the intended ship classes are 3000 to 5000 gallons. Oily wastewater generation rate is 300 to 1000 gallons per day. The NIMS is designed to concentrate the oily waste to 1 percent of its original volume since a 1000-gallon per day generation rate, in the worst case, would fill a 5000-gallon WOT with concentrate in 500 days.

6.3.5 Open system design. The NIMS's interfaces as specified in 3.7 should incorporate an open system architecture (OSA) strategy as defined in 6.6.8.

6.4 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, specifications and standards that have been cleared and listed in DoD 5010.12L, Acquisition Management Systems, and Data Requirements Control List (AMSDL) will be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The technical manuals will be acquired under separate contract line item in the contract.

6.5 Design and fabrication guidelines. The component design guidelines provided in this section are based upon past Navy shipboard experience with the oily waste membrane systems. Oily waste membrane systems designed under those guidelines, have successfully met the performance requirements specified herein. These guidelines are intended to assist the contractor in ensuring that the NIMS fully meets those performance requirements. Any deviation from the guidelines provided in this section may be taken under consideration by the procuring activity. However, any such deviation should be fully justified by the vendor and should be based upon submission of specific calculations and NIMS operating and performance data that have been taken under similar environmental conditions (including noise, shock, vibration, and EMI where applicable) with total operating times as those given in the follow-on paragraphs.

6.6 Definitions.

6.6.1 Concentrate. Contaminant-laden fluid discharged by the primary separation system or secondary separation system.

6.6.2 Critical failure. For testing purposes, a critical failure is defined as any fault, failure or malfunction, which causes or may cause:

a. Failure to commence operation, cessation of operation or degradation of performance below specified levels.

b. Damage to the NIMS by continued operation.

c. Safety hazard to personnel.

6.6.3 Effluent. Clean water output from either the primary separator or the secondary separation filtration system. However, for the purpose of this specification, effluent is only used to describe clean water produced by the primary separator.

6.6.4 Feed. The influent stream to be processed by the primary separator or the secondary separation filtration modules.

6.6.5 Maintenance ratio. A maintenance ratio is a measure of the total maintenance manpower burden required to maintain an item. It is expressed as a ratio of the total active maintenance man-hours (scheduled and unscheduled) to the total operating time.

6.6.6 Mean time between critical failure (MTBCF). The total amount of operational time divided by the total number of critical failures during a stated series of missions.

6.6.7 Oily waste holding tank (OWHT). The OWHT receives oily waste from the ship's bilges. It serves as a settling tank and as the source from which the NIMS draws influent.

6.6.8 Open system architecture (OSA). The resulting open system design should optimize predicted life cycle cost and performance, allow advances in technology to be readily incorporated, and provide for rapid reconfiguration of systems to respond to mission or operational requirement changes. The open system design should favor modularity and compatibility with other Fleet assets and should use standard and/or publicly available, nonproprietary interfaces such that new or upgraded functionality can be incorporated from multiple suppliers over the ship's life cycle. The open system design should facilitate operations in combined missions with other services and interagency, multi-national, and non-Government organizations.

6.6.9 Permeate. Clean fluid obtained by the membrane filtration.

6.6.10 Preventive maintenance. All actions performed in an attempt to retain an item in specified condition by providing systematic inspection, detection, and prevention of incipient failures.

6.6.11 Subsystem. A subsystem is a system within one of the defined systems.

6.6.12 Trans membrane pressure. Trans membrane pressure is the differential pressure between the filtration module's average concentrate pressure and permeate pressure.

6.6.13 Volume reduction factor. Volume reduction factor is the amount of secondary separation system influent compared to the amount of secondary separation concentrate discharged (i.e., 100:1 equals 1 gallon of concentrate for 100 gallons of influent).

6.6.14 Waste oil tank (WOT). The WOT receives oily waste and bulk oil from the NIMS for later disposal ashore.

6.7 Subject term (key word) listing.

a. Filtration

b. Membrane module

c. Oil pollution abatement

d. Oily waste holding tank

e. Open system architecture

f. OSA

g. OWHT

h. Ultrafiltration

i. Waste oil tank

j. WOT

Custodians:
Army – AT
Navy - SH
Air Force - 99

Preparing activity:
Navy - SH
(Project 4610-0026)

Review activities:
Army – GL, GL4
Navy – YD
Air Force – 03, 84
DLA – CC
CIV – 7FLE